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Computation of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank

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ABSTRACT

Development of consistent management by Canada and the USA for the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank led to a sharing allocation proposal. The proposal was founded on agreement about management units, the principles upon which allocation shares would be determined, and computational formulae. For the purpose of developing a sharing proposal, agreement was reached that the transboundary management unit for Atlantic cod and haddock would be limited to the eastern portion of Georges Bank (DFO Statistical Unit Areas 5Zj and 5Zm; USA Statistical Areas 551, 552, 561 and 562) and the management unit for yellowtail flounder would comprise the entire Georges Bank east of the Great South Channel (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; USA Statistical Areas 522, 525, 551, 552, 561 and 562). Two principles were incorporated in the sharing proposal. It was affirmed that fishermen were entitled to the resources that occur in their own nation's waters and recognition was given to historical involvement in the fisheries. Computational formulae were developed that accounted for both historical utilization and changes in resource distributions. Resource utilization was based on reported landings during 1967 through 1994. Resource distributions are determined from NMFS and DFO survey results and are updated annually.

RÉSUMÉ

La décision prise par le Canada et les États-Unis d'adopter des mesures compatibles de gestion des ressources transfrontalières de morue, d'aiglefin et de limande à queue jaune sur le banc Georges a donné lieu à une proposition de partage des allocations. La proposition repose sur une entente conclue au sujet des unités de gestion, des principes régissant la détermination des parts, et une méthode computationnelle. Pour les besoins d'élaboration d'une proposition de partage, les deux pays se sont entendus pour dire que l'unité de gestion transfrontalière pour la morue et l'aiglefin serait limitée à la partie est du banc Georges (zones statistiques de Pêches et Océans 5Zj et 5Zm et zones statistiques américaines 551, 552, 561 et 562) et que l'unité de gestion de la limande à queue jaune comprendrait toute la partie du banc Georges située à l'est du Grand chenal Sud (zones statistiques de Pêches et Océans 5Zh, 5Zj, 5Zm et 5Zn et zones statistiques américaines 522, 525, 551, 552, 561 et 562). Deux principes ont été intégrés dans la proposition de partage : on confirme que les pêcheurs ont le droit de pêcher les ressources qui se trouvent dans les eaux de leur pays respectif et on reconnaît la participation antérieure à la pêche. Des formules computationnelles ont été mises au point qui tiennent compte à la fois de l'utilisation historique et des changements dans la distribution géographique des ressources. Le calcul de l'utilisation des ressources était basé sur les débarquements déclarés entre 1967 et 1994. Le calcul de la répartition géographique des ressources a été déterminé à partir des résultats des relevés menés par le NMFS et le MPO, lesquels sont mis à jour chaque année.

Introduction

The designation of units for management entails a compromise between the biological realities of stock structure and the practical convenience of analysis and policy making (Gulland 1980). For yellowtail flounder, Canada and the USA use a common management unit (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; USA Statistical Areas 522, 525, 551, 552, 561 and 562) comprising the entire bank east of the Great South Channel (Figure 1), referred to hereafter as Georges Bank. For Atlantic cod and haddock, the USA employs a management unit comprising all of Georges Bank and extending south and west of Cape Cod. Canada, however, uses a management unit that comprises only the eastern portion of Georges Bank. The Transboundary Management Guidance Committee (TMGC) agreed that for the purpose of developing a sharing proposal for Atlantic cod and haddock, the management unit would be limited to the eastern portion of Georges Bank (Figure 1; DFO Statistical Unit Areas 5Zj and 5Zm; USA Statistical Areas 551, 552, 561 and 562), referred to hereafter as eastern Georges Bank.

Principles of resource sharing for transboundary stocks may include consideration of a) access to resources occurring or produced within national boundaries and b) historical participation in exploitation of the resources. The latter gives recognition to traditional involvement and investment in development of a fishery. The former has emerged from the effective property rights associated with Exclusive Economic Zones as well as from the significance given to the distribution of stocks occurring in areas under national jurisdiction (UN 1995). The TMGC affirmed that fishermen were entitled to the resources that occur in their own nation's waters. Both principles were incorporated in the TMGC sharing proposal. Historical participation was to be gradually down weighted over an eight year phase-in period, with annual allocations thereafter made primarily (90%) on the basis of resource distributions.

This report documents the computations used to characterize resource utilization and resource distributions relative to the USA/Canada east coast maritime boundary with respect to the USA/Canada sharing arrangement. Gavaris and Murawski (2004) provide a broader account of the considerations regarding consistent management between Canada and the USA for the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank.

Data and Methods

Formula

It was agreed by the TMGC to apply an approach that accounts for historical utilization and that adapts to shifts in resource distribution. The following formula was agreed upon for calculating the respective country shares:

$$\%\text{country share} = \alpha_{year}\ \text{country utilization} + \beta_{year}\ \text{resource distribution}$$

where α_{year} = percentage weighting for utilization in year
β_{year} = percentage weighting for distribution in year
$\alpha_{year} + \beta_{year} = 100\%$

Initial sharing formulas were based on weighting of resource distributions from surveys by 60% and weighting of country utilization by 40%. The percentage weighting would change in equal increments from the starting point to 90% resource distribution from surveys and 10% country utilization. The starting date for the agreement was 2003, with the end of the

transition to a 90/10 weighting formula in the 2010 fishing year according to the following schedule:

2003	2004	2005	2006	2007	2008	2009	2010
60/40	60/40	65/35	70/30	75/25	80/20	85/15	90/10

Resource Utilization

The landings records for 1967- 2000 were examined for assessing historical participation in exploitation of these resources (Table 1). The TMGC agreed to use the percentage of the total 1967-1994 landings inclusive, by country, as the measure of country utilization.

Resource Distribution

Resource distribution patterns were based on USA National Marine Fisheries Service (NMFS) and Fisheries and Oceans Canada (DFO) research vessel bottom trawl survey results. Three different series of surveys were used. Surveys of Georges Bank have been conducted by NMFS during each fall (October) since 1963 and during each spring (April) since 1968, and by DFO in February since 1986. All surveys use a stratified random design. DFO survey sampling strata were revised in 1987 to incorporate the international boundary and only results since 1987 were used. For the NMFS surveys, two vessels have been used during the survey time series and a trawl door change occurred in 1985. Vessel and door conversion factors, derived from comparative fishing experiments (Forrester et al 1997), were applied to the survey results to make the series consistent. Additionally, two different trawl nets were used on the NMFS spring surveys, a modified Yankee 41 during 1973-81 and a Yankee 36 in other years, but no conversion factors are available.

Swept area biomass, considered a relative index of abundance, was computed and apportioned to USA and Canadian sectors in each year. Since the survey designs are based on randomization within strata, the data were post-stratified to USA and Canadian zones within the existing survey strata. The strata and strata sections on each side of the international boundary in the management units used in the analysis are depicted in Figure 2; the strata areas are listed in Table 2. The swept area biomasses of each of the three groundfish species were then summed to derive the biomass index of each species on the USA and Canadian side in each management unit.

The resource sharing allocations are updated annually to reflect temporal and spatial shifts in resource distribution. The nature of the movement and migration of fish is an important consideration in effectively managing shared stocks. Gulland (1980) identified implications for collaborative management resulting from the movements of various life stages of fishes, seasonal migrations, and temporal shifts in distribution.

Spatial distribution patterns may be different among age groups of fishes, particularly between juveniles and adults (Overholtz 1985, Van Eeckhaute et al 1999). However, the contribution to the total biomass index of one or two young age groups should generally be relatively minor, particularly for populations harvested at moderate rates of exploitation. Therefore, age and size specific distribution patterns were ignored in developing estimates from each survey of the total biomass index on each side of the boundary within the designated management units.

The biomass index estimate derived from each survey represents a synoptic snapshot of resource distribution at a specific time during a year. Combining the results of multiple

surveys requires an understanding of seasonal movement patterns and how much of the biological year each survey represents. If directed migrations are not a major feature, each survey can be viewed as an equally representative and independent observation of the average annual resource distribution. A simple average of the available surveys in any year then provides an estimate of the resource distribution and includes all of the survey data. If directed migrations are an important feature, each survey can be associated with the season of the year that it best represents. A simple average of surveys occurring during the same season can then be derived. Seasonal results can subsequently be combined, taking account of the duration of the seasons.

The annual NMFS and DFO survey observations display considerable dispersion. One way of removing both unpredictable fluctuations and sampling variation is to apply a smoothing technique. A desirable smoothing technique is one that makes few assumptions about the form of the trend and the distribution of errors around the predicted trend. A robust locally weighted regression algorithm (Cleveland 1979), referred to as LOESS, was adopted because it was easily implemented and is transparent in how the data are manipulated.

Application of any smoother, including non-parametric types like LOESS, involve some subjective judgment. LOESS requires two subjective inputs: a) the fraction of data used to obtain the 'smooth' at any point, referred to here as the smoothing parameter and b) the number of iterations for robustness. A 30% smoothing parameter was chosen as it established current trends, was responsive to changes, and provided the most pertinent results for contemporary resource sharing. The recommended default of two robustness iterations was adopted. The LOESS smoother was applied to the most recent 33 years of survey data with the latest observations used for the near-term forecast. Resource distributions are updated annually by incorporating data from the latest surveys and dropping data from the earliest year in the survey time series.

Results

The country utilization distributions used in the sharing formula were based on landings during the 1967-1994 period (Table 1) and are:

	USA	CANADA
Eastern Georges Bank Atlantic cod	40%	60%
Eastern Georges Bank haddock	45%	55%
Georges Bank yellowtail	98%	2%

Estimates of biomass indices were calculated for entire strata and for strata that were divided by a management unit boundary or the international boundary unless no observations occurred within a stratum section (Tables 3-11). On the few occasions where no observations were available in a stratum section, density and distribution patterns from adjacent areas and years were used to derive values. While this procedure required judgment, the magnitude of these derived values was generally small and did not unduly influence results. When such values are combined over surveys, they have only a minor effect on the annual aggregate biomass index estimates within the transboundary management units.

The abundance of Atlantic cod declined in the mid 1980s and the biomass index on the USA side declined markedly, particularly in the NMFS fall survey (Figure 3). Most of the Atlantic cod biomass during the NMFS spring surveys (Table 3) and the DFO surveys

(Table 5) is located on the top of the Bank in shallower depths (in NMFS survey strata 16 and 19 and DFO survey stratum 5Z2). In the NMFS fall survey (Table 4), the deeper slope strata have been important for Atlantic cod, but after the late 1980s, the deeper slopes of the Bank (particularly the deeper water on the Canadian side of NMFS survey strata 17 and 21) became even more important as biomass shifted away from the top of the Bank. The percentage of Atlantic cod on the Canadian side during the NMFS spring and DFO surveys is lower than the percentage during the NMFS fall survey, and this difference has become more pronounced since 1980. This pattern is consistent with previous fishery and survey observations that indicated a southwesterly migration of Atlantic cod during the winter-spring period (associated with spawning) and a subsequent return migration to the northeast. The spawning period is rather protracted but tends to peak during March (Smith 1983), near the time when the DFO and the NMFS spring surveys are conducted. Accordingly, the TMGC determined that for Atlantic cod, the DFO and the NMFS spring surveys in each year should be averaged to characterize the distribution during the winter-spring period. This result is then averaged with the NMFS fall distribution percentage, thereby giving equal weight to the winter-spring and summer-fall periods (Table 12). Prior to 1987, when the DFO survey was initiated, the NMFS spring survey was used alone to characterize the winter-spring period.

Haddock abundance peaked during the early 1960s, was high again in the late 1970s and increased during the 1990s (Figure 4). The biomass index on the USA side was exceptionally high during the 1960s. As with Atlantic cod, haddock biomass is concentrated on top of the Bank during both the NMFS and DFO spring surveys (Tables 6 and 8). Since the 1970s, haddock biomass in the fall NMFS surveys has been concentrated in the deeper slope strata (Table 7). Mature haddock display a seasonal migration (Van Eeckhaute et al 1999) associated with spawning. During late winter-early spring, a southwestward movement occurs with peak spawning in April, followed by a northeastward return migration. On face value, this suggests that seasonal averaging of the surveys would be appropriate for haddock. However, the percentage of haddock on each side of the boundary from the DFO survey is somewhat intermediate between the NMFS fall and NMFS spring survey results. Hence, the TMGC considered that it was appropriate to simply average the results from all three surveys to represent the annual pattern (Table 13).

Yellowtail flounder survey abundance was high in the 1960s, declined and remained low during the 1970s and 1980s and increased during the 1990s (Figure 5). The biomass index on the USA side was highest during the 1960s. During all three surveys (Tables 9-11), yellowtail flounder biomass has been highest on the southwest flank of the Bank at the shallower depths in NMFS survey strata 13 and 16 and in DFO survey strata 5Z2 and 5Z4. NMFS survey stratum 19, a shallow depth stratum near the middle of the bank, was important during the 1960s only. Yellowtail flounder are thought to be relatively sedentary during their juvenile and adult benthic stages (Royce et al 1959, Lux 1963). Ontogenetic migration patterns of Georges Bank yellowtail flounder are not well understood, as the age structure of the stock has been truncated over most of the past four decades due to high exploitation. The percentage of yellowtail flounder on each side of the boundary is not significantly different among the three surveys. The TMGC therefore agreed that a simple average of the available survey distribution percentages in each year should be used for this species (Table 14).

For each species, the annual percentage of biomass index on each side of the boundary line was calculated from 1968 onward. Results of the smoothing algorithm for 33 year time periods with the terminal years being 2000, 2001, 2002 and 2003 (used for allocation in fishing years 2002, 2003, 2004 and 2005, respectively) are summarized in Tables 12-14. The percentage of biomass of eastern Georges Bank cod on the Canadian side progressively increased from about 50% in the early 1970s to above 80% in the late 1980s and has since fluctuated between 82% and 85% (Figure 6). The percentage of biomass of eastern Georges Bank haddock in Canadian waters gradually increased from about 60% in the early 1970s to almost 90% in late 1990s, and has subsequently declined to about 75%. The percentage of Georges Bank yellowtail flounder biomass on the Canadian side was about 20% in the 1970s, gradually increased through the to the mid 1990s to about 50%, but has recently declined somewhat.

The fixed resource utilization and the annually updated resource distributions were used in the agreed sharing formula to determine annual country allocations shares for the two countries of each of the three transboundary groundfish species (Table 15).

Discussion

Consistent fisheries management advice utilizing the allocation sharing arrangement was provided for the first time in the 2003 TMGC Guidance Document (TMGC 2003) for application to the 2004 fishing year quotas. It was recognized that the analyses were based on calendar year data but that the fishing year for USA fisheries starts 1 May and ends 30 April. The fishing year for Canadian fisheries starts 1 January and ends 31 December. The TMGC concluded that the most appropriate combined Canada/USA Total Allowable Catch for Eastern Georges Bank cod for the 2004 fishing year was 1,300 mt, which entitled the USA to 23% and Canada to 77%, resulting in a national quota of 300 mt for the USA and 1,000 mt for Canada. The TMGC concluded that the most appropriate combined Canada/USA Total Allowable Catch for Eastern Georges Bank haddock for the 2004 fishing year was 15,000 mt, which entitled the USA to 34% and Canada to 66%, resulting in a national quota of 5,100 mt for the USA and 9,900 mt for Canada. The TMGC concluded that the most appropriate combined Canada/USA Total Allowable Catch for Georges Bank yellowtail flounder for the 2004 fishing year was 7,900 mt, which entitled the USA to 76% and Canada to 24%, resulting in a national quota of 6,000 mt for the USA and 1,900 mt for Canada.

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Table 1. Landings of cod, haddock and yellowtail flounder from the transboundary management units on Georges Bank (see Figure 1).

	Eastern Georges Bank Cod			Eastern Georges Bank Haddock			Georges Bank Yellowtail Flounder		
	Canada	USA	Total	Canada	USA	Total	Canada	USA	Total
1967	8188	3115	11303	12999	11999	24998	133	8407	8540
1968	9055	3244	12299	9195	7646	16841	122	12799	12921
1969	5876	3676	9552	3941	6621	10562	327	15944	16271
1970	2580	3211	5791	1970	3154	5124	70	15505	15575
1971	2950	4389	7339	1610	3533	5143	102	11878	11980
1972	2535	2708	5243	609	1551	2160	8	14157	14165
1973	3222	3064	6286	1565	1396	2961	12	15899	15911
1974	1370	3792	5162	462	955	1417	5	14607	14612
1975	1833	3108	4941	1353	1705	3058	8	13205	13213
1976	2320	2037	4357	1362	974	2336	11	11336	11347
1977	6156	4256	10412	2871	2428	5299	38	9444	9482
1978	8777	5502	14279	9968	4724	14692	56	4519	4575
1979	5979	6408	12387	5080	5212	10292	17	5475	5492
1980	8065	6418	14483	10017	5615	15632	81	6481	6562
1981	8498	8092	16590	5658	9075	14733	12	6182	6194
1982	17825	8565	26390	4872	6280	11152	18	10634	10652
1983	12131	8573	20704	3208	4453	7661	43	11350	11393
1984	5761	10551	16312	1463	5120	6583	4	5764	5768
1985	10442	6641	17083	3484	1684	5168	3	2477	2480
1986	8411	5697	14108	3415	2201	5616	27	3041	3068
1987	11844	4793	16637	4703	1418	6121	56	2743	2799
1988	12740	7645	20385	5941	1694	7635	47	1866	1913
1989	7895	6182	14077	3060	785	3845	32	1134	1166
1990	14364	6414	20778	3340	1188	4528	13	2751	2764
1991	13459	6353	19812	5423	931	6354	25	1784	1809
1992	11673	5080	16753	4090	1629	5719	15	2859	2874
1993	8524	4027	12551	3725	424	4149	675	2089	2764
1994	5278	1229	6507	2412	32	2444	2139	1589	3728
1995	1099	638	1737	2062	22	2084	470	410	880
1996	1921	757	2678	3666	35	3701	472	777	1249
1997	2919	551	3470	2749	47	2796	809	969	1778
1998	1893	828	2721	3362	311	3673	1175	1836	3011
1999	1818	1151	2969	3679	355	4034	1992	2066	4058
2000	1572	662	2234	5402	188	5590	2860	3678	6538
Totals 1967-94									
	217751	144770	362521	117796	94427	212223	4099	215919	220018
Percentage									
	60.1%	39.9%		55.5%	44.5%		1.9%	98.1%	

Table 2. Strata and strata section areas used in the calculation of biomass indices. The designation 'eGB' denotes the eastern Georges Bank management unit used for cod and haddock. The designation '~eGB' denotes the portion of the strata not in the eastern Georges Bank management unit.

	Canada (sq. nm.)	USA(eGB) (sq. nm.)	USA(~eGB) (sq. nm.)
		DFO Strata	
5Z1	795	0	0
5Z2	1252	0	0
5Z3	0	1504	791
5Z4	0	1350	1729
		NMFS Strata	
13	0	0	2374
14	0	0	656
15	0	0	230
16	1553	1427	0
17	284	76	0
18	127	45	0
19	0	1059	1395
20	0	335	886
21	210	78	136
22	125	106	223

Table 3. Cod biomass index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1968	1543	2053		313		16	2762	0	335	70	0		4640	2451
1969	1876	4015	0	264	0	0	2413	2882	452	0		0	7623	4278
1970	948	4877	0	375	0	28	520	809	164	0		0	2441	5280
1971	3071	4267	0	258	0	0	2376	383	0	365		0	5830	4890
1972	1322	5875	0	69	0	0	3749	1378	68	669		32	6518	6645
1973	16082	13420		136	0	195	6119	47331	275	1004	405	279	70212	15035
1974	8700	13169	0	230		32	2681	260	92	872	0	68	11733	14370
1975	2515	3220	0	370		12	6365	20482	20	287		119	29382	4008
1976	2017	2302		567		5	4949	5985	81	527	0		13032	3402
1977	694	2118	0	218	0	0	2073	1872	227	2055	100	0	4966	4391
1978	3959	6849	25	627	0	9	2584	407		2262	155	2627	7129	12375
1979	2044	5988	0	405		94	436	751	711	1357	206	42	4148	7885
1980	6542	10355	83	460		123	995	981	152	655	112	212	8865	11895
1981	4839	1927	103	894			2235	3654	489	821	72	1495	11391	5137
1982	476	123809	27	146	222	286	460	2591		483	196	993	3972	125717
1983	549	7246	246	784	0	93	0	8737	619	588	106	253	10258	8963
1984	1532	1527	78	239	0	0	793	4797	0	250	301	223	7500	2240
1985	1142	9618	29	57	0	159	2886	3032		1239		675	7088	11747
1986	1504	5622	103	45	0	13	2824	298	23	1712		425	4751	7817
1987	1430	3370	0	497	0	23	549	804	74	305		250	2856	4444
1988	1236	4560	0	334		42	1403	243	60	1229	0	269	2942	6432
1989	583	4630	0	33		9	1875	550	0	250		0	3008	4923
1990	1128	4693	0	519		146	475	449	57	108		603	2110	6068
1991	559	3512		178		157	1920	154	115	617		36	2748	4499
1992	0	2116		293		9	491	316	55	639		1240	862	4296
1993	749	695		1322		0	2229	472		134		229	3451	2380
1994	143	0	0	21	0		96	43	36	658		73	318	752
1995	350	7548		63	0		302	503		265		150	1154	8026
1996	1161	1545		221		0	1211	74	358	1653	0	0	2803	3419
1997	756	1561	11	107	0	28	471	0	116	176		343	1355	2214
1998	235	6238	0	187		72	0		110	5408	186	263	531	12168
1999	1053	2482	0	13		0	337	667	0	338	495	25	2552	2858
2000	1458	3281	0	11	0		967	1513	27	302		96	3965	3691
2001	191	1795		59		0	275	166	207	155		340	839	2349
2002	1341	2243	0	23		46	318		0	477	0	64	1659	2851
2003	478	3194	25	50		0	387	61	242	318	149	131	1342	3694

Table 4. Cod biomass index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS fall survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1963	385	6654	0	0	0		3851	2806	245	2313	0		7287	8968
1964	0	5453	0	230	0	0	1089	750		1180		0	1840	6864
1965	0	1328		32	0	42	0	125	143	386	27	322	295	2110
1966	0	1414	0	68	0	779	386	467	6	480	0	280	859	3021
1967	1799	1421	0	1661	0	228	2876	1908	98	386		96	6682	3793
1968	0	226	0	445		134	515	640	81	432		849	1236	2087
1969	23	495	0	104		37	309	516	45	316	0	772	893	1723
1970	0	461	0	0		249	1445	1718	143	679		286	3306	1674
1971	19	1439	0	744	0	0	1089	2165	11	131		0	3285	2314
1972	815	2016		314	0	0	0	0	138	310	0		953	2639
1973	54	3215	0	572	0	149	1944	5096	33	949			7128	4886
1974	0	601	0	0	0	46	0	1227	0	2160	0	0	1227	2807
1975	0	2742		323	0	182	0	1094	18	255	0	10	1112	3513
1976	79	3547	0	21	0	36	51	1150	87	1148	0	71	1367	4824
1977	165	1770	0	475	0	322	602	2963	423	1353	253	129	4407	4050
1978	0	4898	0	345	0	213	1684	303	1105	744	242	557	3333	6756
1979	1084	7191	0	225		747	914	1141	157	754	40	40	3336	8957
1980	0	784	0	1049	0	34	529	805	11	536	39	182	1385	2585
1981	65	3498	31	1156	0	36	713	588	80	701	18	41	1495	5431
1982	0	382		250		0	0	491	11	655	146	0	648	1286
1983	0	352		74	0	36	0	255	15	1289	18		288	1751
1984	0	3745		495	0	838	0	244		345	0		244	5423
1985	0	1926		189	0	85	0	1	9	98		16	10	2313
1986	138	722		217	0	102	0	0	710	147	0	0	848	1187
1987	0	1359		52		260	0	0	166	294	51	41	217	2006
1988	0	2154		251		610	2	6		385	30	1400	38	4799
1989	0	2329		216	0		0	7	3	893	23	13	33	3451
1990	12	2647	0	285		27	0	0		1014		16	12	3989
1991	0	118		109	0			0	0	88	0	7	0	322
1992	57	643	0	704		0	0	35	13	380		57	105	1784
1993	0	92		188		0	0	0		54		26	0	361
1994	0	56		157		201	0	0	7	1583		0	7	1997
1995	0	23		127		71	0	67	28	1171	0		95	1392
1996	0	652		311		48	0		66	181		93	66	1284
1997	0	0		57		0	0	0		1285		0	0	1342
1998	0	1031		31		170	0	0		769			0	2001
1999	0	58		154		56	0	0		465	22	15	22	748
2000	0	269		226		48	0	0	0	234	0	0	0	778
2001	40	423		431		0	0	0	0	288		9	40	1151
2002	0	2955	0	366		34	207	0	0	7312	61	16	268	10684
2003	0	133		0		0	135	0	0	405		23	135	561

Table 5. Cod biomass index by strata sections of eastern Georges Bank (see Figure 2) from the DFO survey.

	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	1555	5826	1345	98	1443	7381
1988	1894	12927	3856	775	4631	14821
1989	2040	8664	2766	1076	3842	10704
1990	1708	48900	4622	1435	6057	50608
1991	2204	17398	3820	1646	5467	19601
1992	2087	7602	4005	887	4892	9689
1993	719	9427	3875	2524	6399	10146
1994	817	11821	455	47	502	12638
1995	919	3277	3368	553	3921	4197
1996	1090	22489	3927	4667	8594	23579
1997	377	7336	2095	1196	3290	7714
1998	332	4091	551	32	583	4423
1999	211	6880	1206	880	2086	7092
2000	228	21947	9281	842	10123	22174
2001	1499	15563	257	718	975	17062
2002	2298	17043	309	683	992	19341
2003	720	3571	1130	797	1927	4291

Table 6. Haddock biomass index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1968	4767	5197		856		84	4637	1012		29	226	203	10642	6367
1969	11660	2342	0	1141	0	0	1914	71	0	44	152	137	13797	3664
1970	36753	2583	0	448	0	0	1381	120	201	73	18	159	38474	3263
1971	1102	469	0	194	3	0	1215	0	240	38		1097	2561	1798
1972	1017	3843	0	20	0	0	856	0	278	393		0	2151	4256
1973	2320	5270		113	0	0	1546	207	42	86	0	1284	4116	6752
1974	718	13765	0	77		6	4334	0		194	0		5052	14042
1975	4047	7002	0	59		0	1203	0	24	8076		34	5273	15171
1976	1955	1802		229		0	1003		2	856	0		2961	2887
1977	323	3283	0	43	0	0	1165	1242	41	13720	0	0	2771	17046
1978	6884	11740	6	56	0	24	2520	0	121	9148		151	9531	21119
1979	3715	12218	10	84		0	1049	0	103	987	260	2005	5137	15294
1980	21009	6764	13	263		67	26933		0	18795	82	96	48036	25985
1981	12286	15870	2	44			9096	3890		4215	370	944	25642	21073
1982	3830	8719	131	348	0	11	1200	859		2342	91	1029	6112	12450
1983	1487	5525	21	668	0	0	0	708	61	3999	464	368	2741	10559
1984	3539	4784	8	168	0	0	1497		2	154	120	170	5166	5276
1985	1793	8819	14	99	0	18	167	0		3696		54	1974	12686
1986	1210	6880	0	21	0	0	367	0	0	1297		0	1578	8197
1987	245	7607	0	101	0	17	0	1005		63		69	1250	7856
1988	3085	2097	0	13		0	169	0	0	310	0	0	3255	2419
1989	5778	2961	28	146		79	123	0	0	751		256	5929	4193
1990	1612	8848	0	64			0	0	33	1305		21	1645	10238
1991	1012	6001		37		0	0	0	0	28		0	1012	6067
1992	442	1530		80		0	93	0		376		0	536	1986
1993	266	3234		439		0	0	0		387		154	266	4214
1994	2	801	11	1	0		0		6	5644		0	19	6446
1995	2297	578	42	60	0		778	0	2	3356		888	3119	4881
1996	3720	1021	23	32		0	8581	0	8	972	31	0	12362	2026
1997	218	1884	10	28	0	11	0	0	45	1239		74	273	3237
1998	574	6600	3	84		5	0		282	227	0	108	859	7024
1999	6267	3485	0	1598		0	0	74	42	366	37	38	6420	5487
2000	4238	3712	0	220	0		198	668	522	151		55	5626	4138
2001	297	1537		446		0	71	0	1215	4339		15	1583	6337
2002	13973	9781	0	332		15	8094		0	897	93	78	22161	11103
2003	2149	14472	2	77		0	699	291	1123	1438	19	46	4282	16034

Table 7. Haddock biomass index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS fall survey. Shaded cells represent missing values calculated from adjacent strata sections. Blank cells represent missing values assumed to be zero.

	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA 22	CAN 22	USA total	CAN total
1963	12153	8911	0	1892	0	2127	27496	1401	541	2689	240	194	41832	15814
1964	26324	5986	227	851	0	957	25601	9150	1531	2158	442	34	63275	9986
1965	6109	8981		773	0	687	16273	2064	112	2492	498	1114	25056	14047
1966	2640	8170	26	142	0	287	11825	1985	6	308	618	210	17100	9115
1967	1372	1700	0	448	22	304	2377	425	1884	193		360	6080	3005
1968	0	8032	0	129		377	0	71	21	0		651	92	9188
1969	599	0	0	146		0	1107	1927		86	0	102	3633	333
1970	27	743	8	555		542	9156	0	32	1035		274	9223	3149
1971	244	361	0	356	0	57	2463	0	112	29		470	2819	1272
1972	151	1143		685	0	43	0	0	0	0	72	204	223	2076
1973	83	9296	0	811	0	26	0	0		36			83	10169
1974	0	586	0	99	0	35	0		0	560	341	0	341	1279
1975	560	747		1322	0	226	0	425		0	37	540	1022	2835
1976	0	44340	0	375	0	307	0			9637	152	724	152	55381
1977	4	2886	0	623	0	510	88	0	482	24478	253	3131	827	31628
1978	133	1848	0	6727	0	1074	475	9	0	872	120	490	737	11010
1979	2561	2193	5	143		871	0	2		730	575	3233	3143	7171
1980	5	1228	0	4167	0	394	647	44	228	363	51	850	974	7002
1981	647	4886	213	2349	0	348	5	20	266	570	316	552	1467	8705
1982	162	1919		2889		1423	0	0	26	60	128	14	316	6305
1983	95	334		1061	0	506	0	0		197	262	333	357	2431
1984	0	308		1603	0	455	0	0		71	152	194	152	2632
1985	497	590		739	0	395	0	0	7	453		18	504	2195
1986	0	2368		1383	0	465	0	0	16	2079	0	26	16	6321
1987	7	8		320		140	8	7	0	205	0	239	22	911
1988	50	1134		366		1588	0	0		1724	0	413	50	5224
1989	4	528		987	2	1114	0	8	6	1331	46	296	66	4257
1990	51	29	0	1396		401	0	0		885		132	51	2842
1991	20	92		561	0	0		0	8	0	0	178	28	831
1992	171	292	0	585		173	0	8	0	6		21	179	1077
1993	0	443		217		0	0	0		4103		83	0	4846
1994	0	0		284		347	0	0	0	1162		0	0	1793
1995	4	5214		843		1373	0	0	0	6575	0		4	14005
1996	10	2057		1138		639	0		1	179		0	10	4012
1997	0	4		133		0	2	5	8	6012		0	15	6149
1998	7	3409		285		471	0	37	7	2241			51	6406
1999	0	151		113		2021	0	0		13900	0	0	0	16184
2000	100	1646		365		1351	0	0	0	9432	0	0	100	12795
2001	1013	1471		2264		395	0	0	0	21540		491	1013	26161
2002	314	21420	8	591		201	0	144	0	19620	206	223	671	42054
2003	2736	3312		331		95	342	219	123	6453		0	3420	10191

Table 8. Haddock biomass index by strata sections of eastern Georges Bank (see Figure 2) from the DFO survey.

	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	2661	12956	375	99	475	15617
1988	1350	16559	8305	96	8401	17909
1989	982	9377	641	198	839	10359
1990	3943	15963	3424	4155	7579	19907
1991	3084	13597	7383	3260	10643	16680
1992	3544	10403	5953	576	6530	13946
1993	2064	2367	110	2411	2521	4432
1994	8871	9968	19	90	108	18839
1995	2244	18041	336	0	336	20285
1996	4947	16985	440	839	1279	21933
1997	1853	11022	1298	179	1476	12875
1998	15844	29323	89	11	99	45167
1999	14775	15221	506	319	825	29996
2000	4682	41522	11048	158	11206	46205
2001	9471	43754	2022	513	2535	53225
2002	5695	28569	3391	11863	15254	34264
2003	1583	89462	4334	27407	31741	91045

Table 9. Yellowtail flounder biomass index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS spring survey. Blank cells represent missing values assumed to be zero.

	USA 13	USA 14	USA 15	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA total	CAN total
1968	326	0	0	1228	413		0		0	1052	99	0	0	2705	413
1969	2239	0	0	1524	633	22	0	0	0	7425	107	100	0	11416	633
1970	2975	0	0	773	156	29	0	0	0	1359	653	17	0	5806	156
1971	2114	29	0	1146	183	0	0	0	0	1284	0	49	0	4622	183
1972	2056	10	0	1505	1307	0	0	0	0	1979	214	0	0	5764	1307
1973	1204	6	0	862	611		5	0	0	367	83	5	317	2528	932
1974	782	0	0	623	522	0	0		0	870	214	0	0	2488	522
1975	258	17	0	344	781	0	0		0	349	89	0		1057	781
1976	835	0	0	375	674		6		0	430	107	2	0	1748	680
1977	152	7	0	124	666	0	0	0	0	30	20	0	37	332	703
1978	224	7	0	119	180	0	3	0	0	159	90	7	0	607	182
1979	312	0	0	193	422	5	9		0	315	20	5	0	849	432
1980	933	0	0	387	2300	0	131		2	389	81	2	4	1793	2437
1981	211	9	0	1035	137	0	25			185	19	0	73	1459	235
1982	1202	0	3	175	563	0	10	0	4	694	0	10	0	2084	578
1983	355	13	0	431	799	0	73	0	3	1023	161	16		1999	875
1984	135	0	0	342	747		0	0	0	265	201	16	0	960	747
1985	127	0	0	200	473	0	0	0	3	131	55	0	0	512	475
1986	190	0	0	68	584	0	0	0	0	71	0	9	20	338	604
1987	66	0	0	114	102	0	0	0	0	71	0	2	0	253	102
1988	193	0	0	183	146	0	0		0	46	6	40	0	467	146
1989	179	0	0	115	322	0	0		0	65	2	2	3	363	324
1990	545	0	0	30	117	0	7			37	0	0	0	612	124
1991	233	0	0	139	286		0		0	7	0	0	0	380	286
1992	295	0	0	178	1200		9		0	169	45	0	25	688	1233
1993	84	0	0	83	349		8		0	49	0	0	6	217	363
1994	103	0	0	127	383	0	0	0		70	0	55	37	356	419
1995	298	0	0	439	1854		0	0		41	12	4	44	794	1898
1996	103	0	0	1020	1724		9		0	229	120	13	23	1485	1756
1997	95	0	0	432	3631	0	0	3	0	35	59	2	0	626	3631
1998	704	0	0	910	676	0	0		0	38	65	19	302	1737	978
1999	768	0	0	2571	6830	0	0		0	5	67	36	3	3448	6833
2000	681	0	0	2003	4927	0	6	0		180	33	61	0	2956	4933
2001	61	0	0	2486	2389		8		0	101	20	240	17	2908	2413
2002	66	0	0	3656	3876	0	0		0	663	8	4	3150	4397	7026
2003	173	0	0	895	6384	0	28		0	21	0	14		6412	1103

Table 10. Yellowtail flounder biomass index by strata sections of eastern Georges Bank (see Figure 2) from the NMFS fall survey. Blank cells represent missing values assumed to be zero.

	USA 13	USA 14	USA 15	USA 16	CAN 16	USA 17	CAN 17	USA 18	CAN 18	USA 19	USA 20	USA 21	CAN 21	USA total	CAN total
1963	6254	153	15	1741	477	84	41	5		2136	3102	13	0	518	13502
1964	10125	60	0	1102	114	26	33	0	0	3324	113	0	7	154	14751
1965	6677	24	0	247	80		17	0	0	1451	1419	62	0	97	9879
1966	669	0	0	164	1336	5	5	0	0	1351	353	25	4	1345	2566
1967	1622	10	23	2359	0	119	0	0	0	2202	495	0	0	0	6830
1968	2864	0	0	2143	1491	9	0		0	4178	323	5	0	1491	9521
1969	2927	0	0	1859	298	86	0		0	3738	156	7	0	298	8773
1970	1519	0	0	632	424	75	0		0	2206	318	62	0	424	4812
1971	3359	19	9	1766	179	0	0	3	4	1222	0	137	0	183	6514
1972	4504	29	0	1827	306		0	0	0	339	0	232	0	306	6930
1973	1867	0	0	2225	2377	5	0	0	0	178	13	349	36	2414	4638
1974	2286	0	0	749	825	0	0	0	0	126	0	0	0	825	3160
1975	770	19	0	936	747		0	0	0	80	36	0	0	747	1842
1976	128	0	0	1070	167	0	75	0	0	17	63	55	34	276	1333
1977	139	123	0	712	1765	0	7	0		109	91	60	0	1772	1235
1978	1129	0	0	838	336	0	78	0	0	151	31	1	0	414	2151
1979	479	0	0	739	156	0	5		0	9	45	48	4	165	1320
1980	40	14	0	1975	3869	8	26	0	0	970	93	110	173	4068	3211
1981	941	0	0	1250	106	0	0	0	0	190	0	22	0	106	2403
1982	1512	0	0	110	603		0		0	105	23	42	0	603	1792
1983	753	0	0	731	676		0	0	0	0	0	141	0	676	1625
1984	304	0	0	201	85		5	0	0	31	0	45	17	108	581
1985	141	0	0	405	171		4	0	0	0	0	0	38	212	547
1986	208	0	0	438	155		0	0	0	8	2	4	0	155	659
1987	69	0	0	193	267		0		0	16	0	0	0	267	278
1988	18	0	0	121	60		0		0	0	4	0	13	73	144
1989	794	0	0	202	83		0	0		9	21	0	0	83	1026
1990	388	0	0	282	76	0	0		0	32	0	0	0	76	702
1991	90	0	0	661	99		0	3		0	0	25	0	99	779
1992	177	0	0	9	419	0	0		0	16	22	0	0	419	224
1993	47	0	0	24	327		12		0	0	7	18	0	339	96
1994	113	0	0	105	755		18		0	11	0	118	19	792	347
1995	47	0	0	80	214		0		0	3	10	71	0	214	211
1996	90	0	0	1494	284		0		0	0	0	10	0	284	1593
1997	232	0	0	1808	1999		0		0	38	0	37	3	2003	2115
1998	818	0	0	592	2364		3		0	0	20	5	0	2367	1435
1999	770	0	0	2935	3962		191		0	224	114	157	0	4154	4200
2000	171	0	0	5580	1097		4		0	60	22	144	20	1121	5978
2001	641	0	0	7877	2139		13		0	177	47	111	0	2153	8853
2002	161	0	0	1784	1861	0	7		0	5	10	214	75	1943	2174
2003	92	0	0	2825	1613		0		0	158	0	43	3	1616	3119

Table 11. Yellowtail flounder biomass index by strata sections of eastern Georges Bank (see Figure 2) from the DFO survey.

	CAN 5Z1	CAN 5Z2	USA 5Z3	USA 5Z4	USA total	CAN total
1987	69	750	102	343	445	819
1988	30	253	136	816	952	283
1989	29	111	50	281	331	140
1990	39	358	129	1053	1181	397
1991	57	444	262	996	1258	501
1992	119	432	327	1599	1925	550
1993	59	1634	178	771	949	1693
1994	91	501	745	1417	2162	591
1995	35	785	487	719	1206	820
1996	35	2799	1229	1241	2470	2833
1997	868	2464	2431	7529	9960	3332
1998	93	2484	613	1102	1715	2577
1999	190	6616	408	10452	10860	6806
2000	2019	5526	6430	5974	12404	7545
2001	443	4995	963	15757	16720	5438
2002	66	5052	5854	9727	15581	5118
2003	48	5739	75	10387	10462	5786

Table 12. Smoothed resource distribution for eastern Georges Bank cod. The combined distribution was obtained by averaging the NMFS spring and DFO surveys to represent winter-spring and subsequently averaging with NMFS fall which represented summer-fall.

									smoothed							
	NMFS fall		NMFS spring		DFO		combined		final year 2000		final year 2001		final year 2002		final year 2003	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1968	63	37	35	65			49	51	49	51						
1969	66	34	36	64			51	49	50	50	50	50				
1970	34	66	68	32			51	49	50	50	50	50	50	50		
1971	41	59	46	54			43	57	51	49	50	50	50	50	48	52
1972	73	27	50	50			62	38	51	49	50	50	50	50	49	51
1973	41	59	18	82			29	71	51	49	50	50	50	50	49	51
1974	70	30	55	45			62	38	51	49	50	50	50	50	50	50
1975	76	24	12	88			44	56	50	50	50	50	50	50	50	50
1976	78	22	21	79			49	51	52	48	52	48	52	48	52	48
1977	48	52	47	53			47	53	55	45	55	45	55	45	55	45
1978	67	33	63	37			65	35	58	42	58	42	58	42	58	42
1979	73	27	66	34			69	31	61	39	61	39	61	39	61	39
1980	65	35	57	43			61	39	64	36	64	36	64	36	64	36
1981	78	22	31	69			55	45	65	35	65	35	65	35	65	35
1982	67	33	97	3			82	18	65	35	65	35	65	35	65	35
1983	86	14	47	53			66	34	67	33	67	33	67	33	67	33
1984	96	4	23	77			59	41	69	31	69	31	69	31	69	31
1985	100	0	62	38			81	19	71	29	71	29	71	29	71	29
1986	58	42	62	38			60	40	74	26	74	26	74	26	74	26
1987	90	10	61	39	84	16	81	19	78	22	78	22	78	22	78	22
1988	99	1	69	31	76	24	86	14	82	18	82	18	82	18	82	18
1989	99	1	62	38	74	26	83	17	85	15	85	15	85	15	85	15
1990	100	0	74	26	89	11	91	9	85	15	85	15	85	15	85	15
1991	100	0	62	38	78	22	85	15	85	15	85	15	85	15	85	15
1992	94	6	83	17	66	34	85	15	85	15	85	15	85	15	85	15
1993	100	0	41	59	61	39	76	24	84	16	84	16	84	16	84	16
1994	100	0	70	30	96	4	91	9	83	17	83	17	83	17	83	17
1995	94	6	87	13	52	48	82	18	83	17	83	17	83	17	83	17
1996	95	5	55	45	73	27	80	20	84	16	84	16	84	16	84	16
1997	100	0	62	38	70	30	83	17	84	16	84	16	84	16	84	16
1998	100	0	96	4	88	12	96	4	83	17	84	16	84	16	84	16
1999	97	3	53	47	77	23	81	19	83	17	85	15	85	15	85	15
2000	100	0	48	52	69	31	79	21	**82**	**18**	86	14	86	14	85	15
2001	97	3	74	26	95	5	90	10			**86**	**14**	87	13	84	16
2002	98	2	63	37	95	5	88	12					**88**	**12**	83	17
2003	81	19	73	27	69	31	76	24							**82**	**18**

Table 13. Smoothed resource distribution for eastern Georges Bank haddock. The combined distribution was obtained by averaging over all surveys.

	NMFS fall		NMFS spring		DFO		combined		smoothed							
									final year 2000		final year 2001		final year 2002		final year 2003	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1968	99	1	37	63			68	32	-5	105						
1969	8	92	21	79			15	85	11	89	12	88				
1970	25	75	8	92			17	83	27	73	26	74	28	72		
1971	31	69	41	59			36	64	42	58	40	60	40	60	62	38
1972	90	10	66	34			78	22	56	44	52	48	51	49	66	34
1973	99	1	62	38			81	19	67	33	66	34	62	38	71	29
1974	79	21	74	26			76	24	75	25	74	26	74	26	75	25
1975	74	26	74	26			74	26	78	22	78	22	78	22	78	22
1976	100	0	49	51			75	25	79	21	79	21	79	21	79	21
1977	97	3	86	14			92	8	78	22	78	22	78	22	78	22
1978	94	6	69	31			81	19	76	24	76	24	76	24	76	24
1979	70	30	75	25			72	28	74	26	74	26	74	26	74	26
1980	88	12	35	65			61	39	72	28	72	28	72	28	72	28
1981	86	14	45	55			65	35	73	27	73	27	73	27	73	27
1982	95	5	67	33			81	19	74	26	74	26	74	26	74	26
1983	87	13	79	21			83	17	78	22	78	22	78	22	78	22
1984	95	5	51	49			73	27	82	18	82	18	82	18	82	18
1985	81	19	87	13			84	16	84	16	84	16	84	16	84	16
1986	100	0	84	16			92	8	84	16	84	16	84	16	84	16
1987	98	2	86	14	97	3	94	6	84	16	84	16	84	16	84	16
1988	99	1	43	57	68	32	70	30	83	17	83	17	83	17	83	17
1989	98	2	41	59	93	7	77	23	81	19	81	19	81	19	81	19
1990	98	2	86	14	72	28	86	14	80	20	80	20	80	20	80	20
1991	97	3	86	14	61	39	81	19	82	18	82	18	82	18	82	18
1992	86	14	79	21	68	32	78	22	84	16	84	16	84	16	85	15
1993	100	0	94	6	64	36	86	14	86	14	86	14	86	14	86	14
1994	100	0	100	0	99	1	100	0	86	14	86	14	86	14	86	14
1995	100	0	61	39	98	2	86	14	87	13	87	13	87	13	87	13
1996	100	0	14	86	94	6	69	31	88	12	88	12	88	12	88	12
1997	100	0	92	8	90	10	94	6	86	14	87	13	87	13	87	13
1998	99	1	89	11	100	0	96	4	84	16	86	14	85	15	85	15
1999	100	0	46	54	97	3	81	19	82	18	85	15	84	16	85	15
2000	99	1	42	58	80	20	74	26	**80**	**20**	85	15	81	19	82	18
2001	96	4	80	20	95	5	91	9			**84**	**16**	77	23	79	21
2002	98	2	33	67	69	31	67	33					**74**	**26**	76	24
2003	75	25	79	21	74	26	76	24							**75**	**25**

Table 14. Smoothed resource distribution for Georges Bank yellowtail flounder. The combined distribution was obtained by averaging over all surveys.

									smoothed							
	NMFS fall		NMFS spring		DFO		combined		final year 2000		final year 2001		final year 2002		final year 2003	
	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA	%CAN	%USA
1968	14	86	13	87			13	87	5	95						
1969	3	97	5	95			4	96	7	93	1	99				
1970	8	92	3	97			5	95	9	91	5	95	3	97		
1971	3	97	4	96			3	97	11	89	10	90	8	92	8	92
1972	4	96	18	82			11	89	14	86	14	86	14	86	13	87
1973	34	66	27	73			31	69	19	81	19	81	18	82	18	82
1974	21	79	17	83			19	81	24	76	24	76	24	76	22	78
1975	29	71	43	57			36	64	25	75	25	75	25	75	25	75
1976	17	83	28	72			23	77	25	75	25	75	25	75	25	75
1977	59	41	68	32			63	37	24	76	24	76	24	76	24	76
1978	16	84	23	77			20	80	21	79	21	79	21	79	21	79
1979	11	89	34	66			22	78	19	81	19	81	19	81	19	81
1980	56	44	58	42			57	43	20	80	20	80	20	80	20	80
1981	4	96	14	86			9	91	21	79	21	79	21	79	21	79
1982	25	75	22	78			23	77	23	77	23	77	23	77	23	77
1983	29	71	30	70			30	70	27	73	27	73	27	73	27	73
1984	16	84	44	56			30	70	32	68	32	68	32	68	32	68
1985	28	72	48	52			38	62	36	64	36	64	36	64	36	64
1986	19	81	64	36			42	58	37	63	37	63	37	63	37	63
1987	49	51	29	71	65	35	48	52	35	65	35	65	35	65	35	65
1988	34	66	24	76	23	77	27	73	32	68	32	68	32	68	32	68
1989	7	93	47	53	30	70	28	72	30	70	30	70	30	70	30	70
1990	10	90	17	83	25	75	17	83	31	69	31	69	31	69	31	69
1991	11	89	43	57	28	72	28	72	36	64	36	64	36	64	36	64
1992	65	35	64	36	22	78	51	49	41	59	42	58	41	59	42	58
1993	78	22	63	37	64	36	68	32	47	53	47	53	47	53	47	53
1994	70	30	54	46	21	79	48	52	50	50	50	50	50	50	50	50
1995	50	50	71	29	40	60	54	46	51	49	51	49	51	49	51	49
1996	15	85	54	46	53	47	41	59	50	50	50	50	50	50	50	50
1997	49	51	85	15	25	75	53	47	49	51	50	50	50	50	50	50
1998	62	38	36	64	60	40	53	47	48	52	47	53	48	52	48	52
1999	50	50	66	34	39	61	52	48	47	53	43	57	45	55	46	54
2000	16	84	63	37	38	62	39	61	**46**	**54**	40	60	43	57	45	55
2001	20	80	45	55	25	75	30	70			**36**	**64**	40	60	45	55
2002	47	53	62	38	25	75	44	56					**38**	**62**	44	56
2003	34	66	85	15	36	64	52	48							**44**	**56**

Table 15. Allocation shares are updated annually based on resource distribution. The weighting of resource utilization to resource distribution changes from an initial ratio of 40:60 to 10:90 by 2010.

	Resource Utilization		
	COD	HADDOCK	YELLOWTAIL
USA	40%	45%	98%
CANADA	60%	55%	2%

	Resource Distribution				*Allocation Shares*				
	Survey Year	COD	HADDOCK	YELLOWTAIL	Fishing Year	Utilization	Distribution	COD	HADDOCK	YELLOWTAIL
USA	**2000**	18%	20%	54%	**2002**	40%	60%	27%	30%	72%
CANADA		82%	80%	46%				73%	70%	28%
USA	**2001**	14%	16%	64%	**2003**	40%	60%	24%	28%	78%
CANADA		86%	84%	36%				76%	72%	22%
USA	**2002**	12%	26%	62%	**2004**	40%	60%	23%	34%	76%
CANADA		88%	74%	38%				77%	66%	24%
USA	**2003**	18%	27%	56%	**2005**	35%	65%	26%	33%	71%
CANADA		82%	73%	44%				74%	67%	29%
USA	**2004**				**2006**	30%	70%			
CANADA										
USA	**2005**				**2007**	25%	75%			
CANADA										
USA	**2006**				**2008**	20%	80%			
CANADA										
USA	**2007**				**2009**	15%	85%			
CANADA										
USA	**2008**				**2010**	10%	90%			
CANADA										

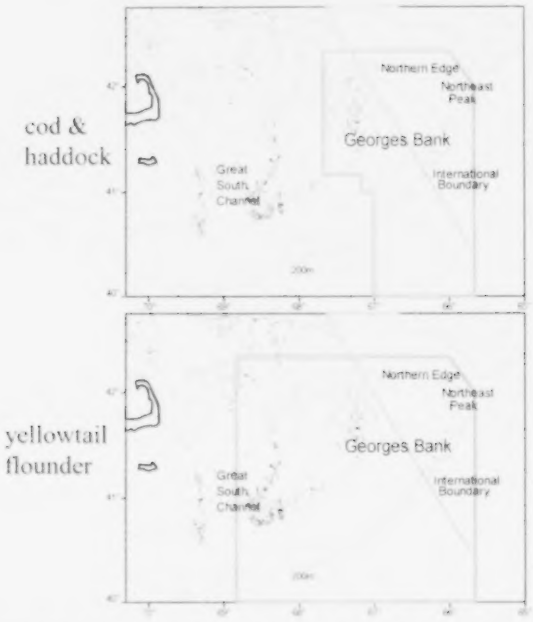

Figure 1. The resource distribution of cod, haddock and yellowtail flounder across the boundary was considered relative to the illustrated management units.

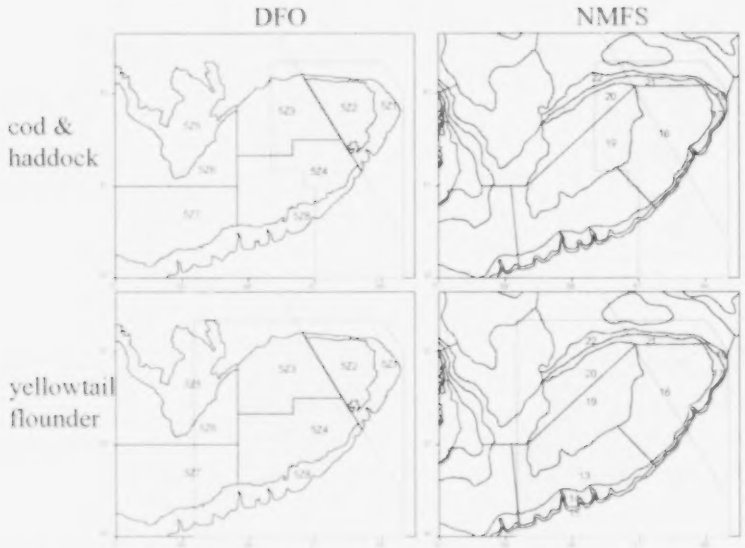

Figure 2. The survey designs were post-stratified to accommodate the international boundary and the management unit borders. Strata boundaries (thin black lines) with strata labels are shown. The shaded area represents the strata and strata sections that were used to approximate the respective management units (thick grey lines).

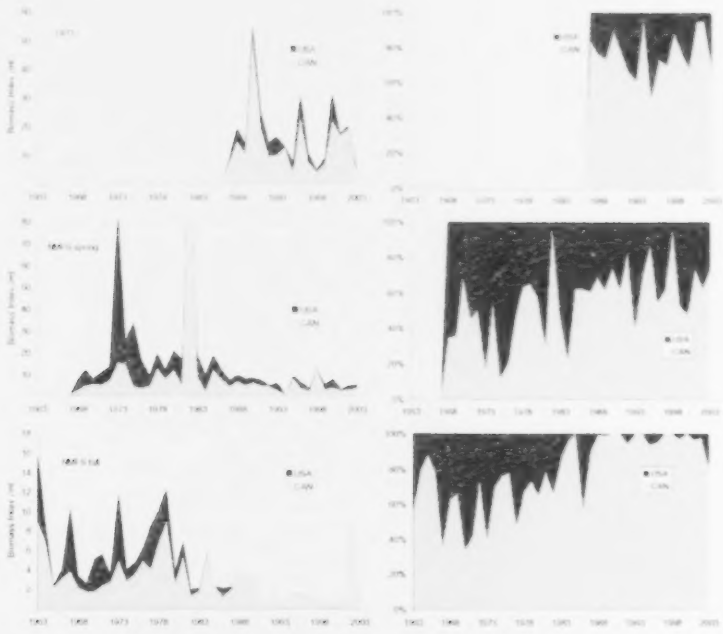

Figure 3. Relative indices of biomass and percentage resource distribution in relation to the international boundary for cod on eastern Georges Bank.

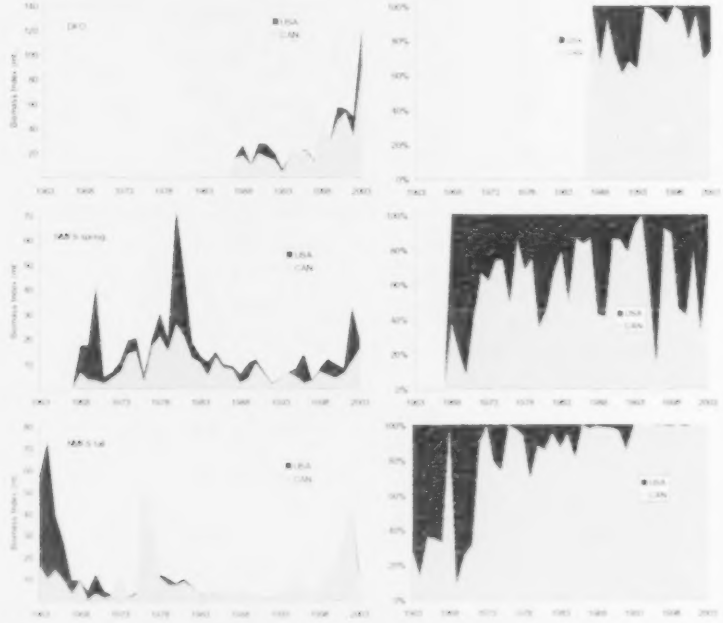

Figure 4. Relative indices of biomass and percentage resource distribution in relation to the international boundary for haddock on eastern Georges Bank .

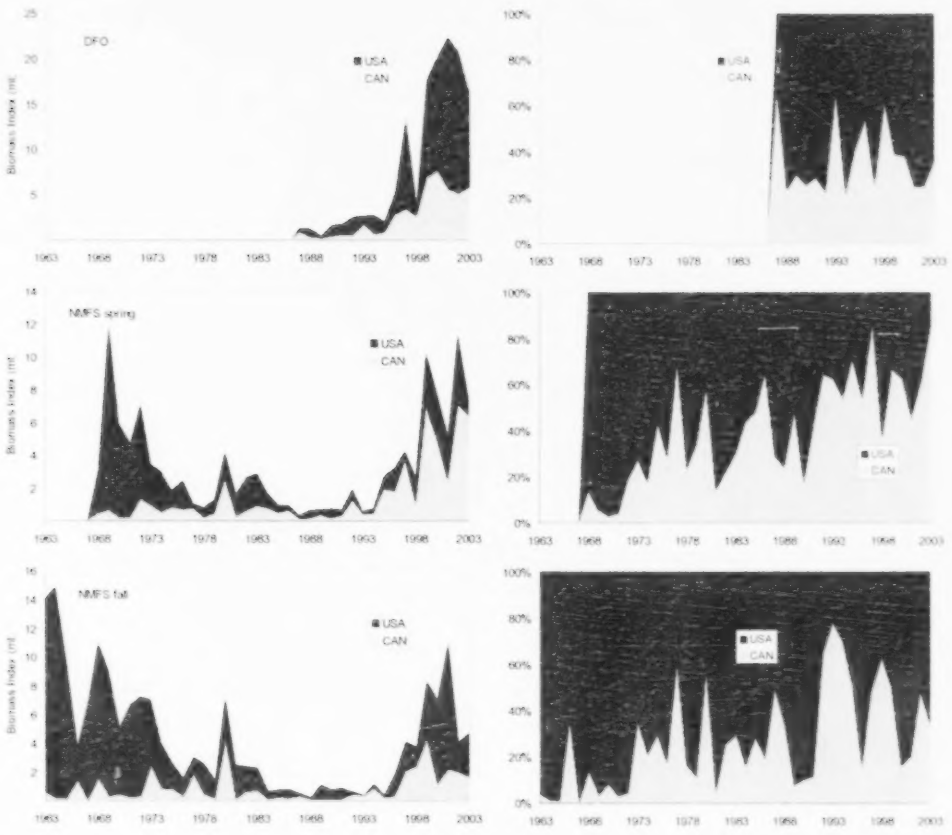

Figure 5. Relative indices of biomass and percentage resource distribution in relation to the international boundary for yellowtail flounder on Georges Bank shown as stacked area charts.

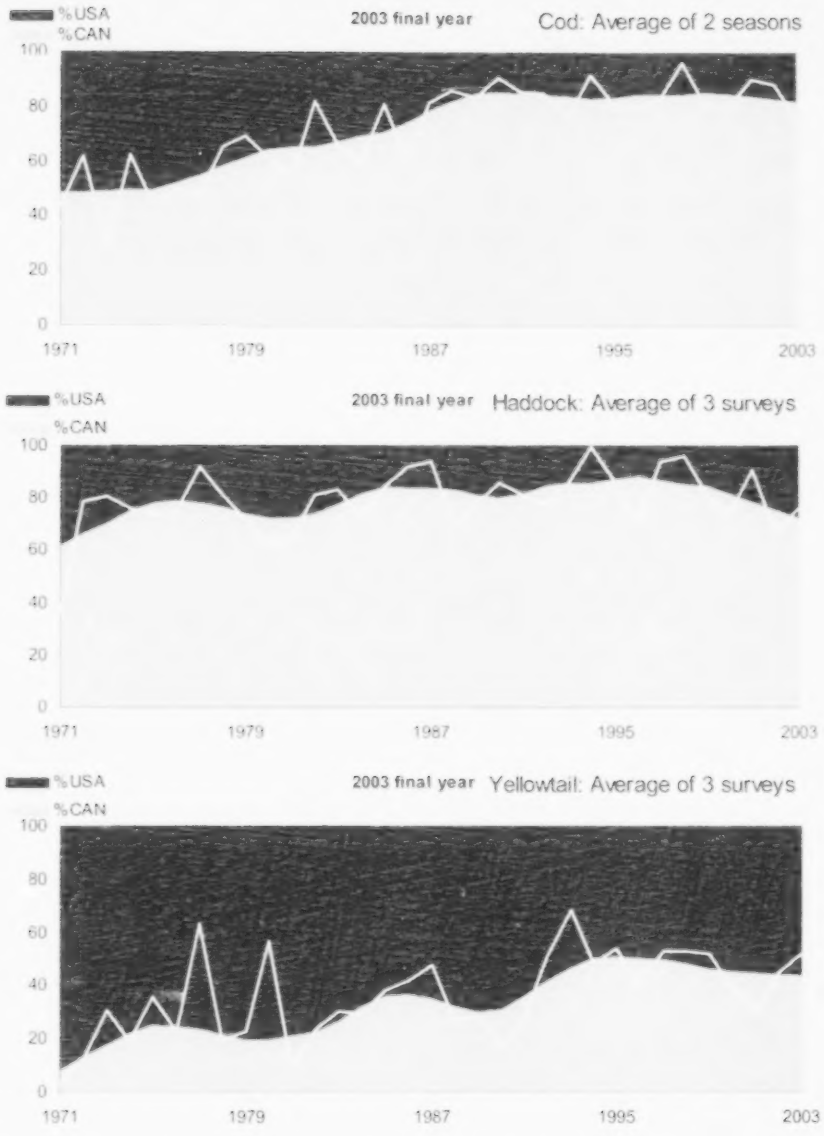

Figure 6. Observed annual percentage and smoothed trends of proportion of eastern Georges Bank cod and haddock and of Georges Bank yellowtail flounder on the Canadian side of the international boundary.